

4. Lynx Habitat Management Guidelines

The management guidelines presented below are organized by planning scale. Table 4.1 outlines the objectives and strategies for each scale. The remainder of the chapter describes each scale and identifies specific guidelines. The guidelines are numbered separately for each scale and are shown in **bold, san-serif type (e.g., 1)**; some include **sub-guidelines (e.g., 1a)** and sub-sub guidelines (e.g., 1a.i). Additional text provides the rationale behind the guidelines, based on current scientific information. Assumptions referred to are those listed (A-E) in Chapter 3.

Table 4.1
Objectives and Management Strategies by Planning Scale

Planning Scale	Ecoprovince and Ecodivision	Lynx Management Zone (LMZ)	Lynx Analysis Unit (LAU)	Ecological Community
Objectives	Encourage genetic integrity at the species level.	Maintain connectivity between sub-populations, within Washington	Maintain the integrity of requisite habitat types within individual home ranges	Provide a diversity of successional stages within each LAU Connect denning sites and foraging sites with forested cover without isolating them with open areas
Management Strategies	Prevent bottlenecks between B.C. and WA by limiting shape and size of temporary non-habitat along the border. Maintain major routes of dispersal between British Columbia and Washington.	Maintain dispersal routes between and within zones Arrange harvest activities that result in temporary non-habitat patches among watersheds so that connectivity is maintained within each zone	Maintain connectivity between and integrity within home ranges used by individuals and/or family groups (within sub-populations)	Prolong the persistence of snowshoe hare habitat Retain coarse woody debris for denning sites

4.1 Ecoprovinces and Ecodivisions

"Ecodivisions" and "ecoprovinces" (Figure 5) are the largest scales considered in the Lynx Plan. They were developed by USFS and British Columbia's Ministry of Environment, Lands, and Parks and are supported by the scientific literature (Ruggiero et al. 1994). By using these common scales, it is easier for DNR to coordinate its lynx management efforts with other state, federal, and Canadian agencies.

Ecodivisions and ecoprovinces are based on macroclimatic processes or, "the relatively permanent atmospheric and geographical factors that govern the general nature of specific climates" (Demarchi 1992). Each ecodivision is usually subdivided by more than one ecoprovince. Within the primary lynx range of Washington, the Humid Continental Highlands Ecodivision of northeastern Washington and the Semi-Arid Steppe Highlands Ecodivision of the eastern Cascades are exclusively represented by the Southern Interior Mountains Ecoprovince and Southern Interior Ecoprovince, respectively (Figure 5).

According to traditional biogeographic theory, lynx in both ecoprovinces of Washington are especially susceptible to extinction due to their "peninsular" distribution (Weaver 1993). That is, the shape of the area they occupy resembles a peninsula. This peninsular shape arises naturally from the distribution of habitats that lynx prefer. At southern latitudes, the boreal habitat and climate conditions needed by lynx are restricted to increasingly higher elevations. Because these narrow mountain ranges have north-south orientations, lynx distribution maps depict peninsula-shaped ranges of habitat separated by lower elevation, less suitable habitat.

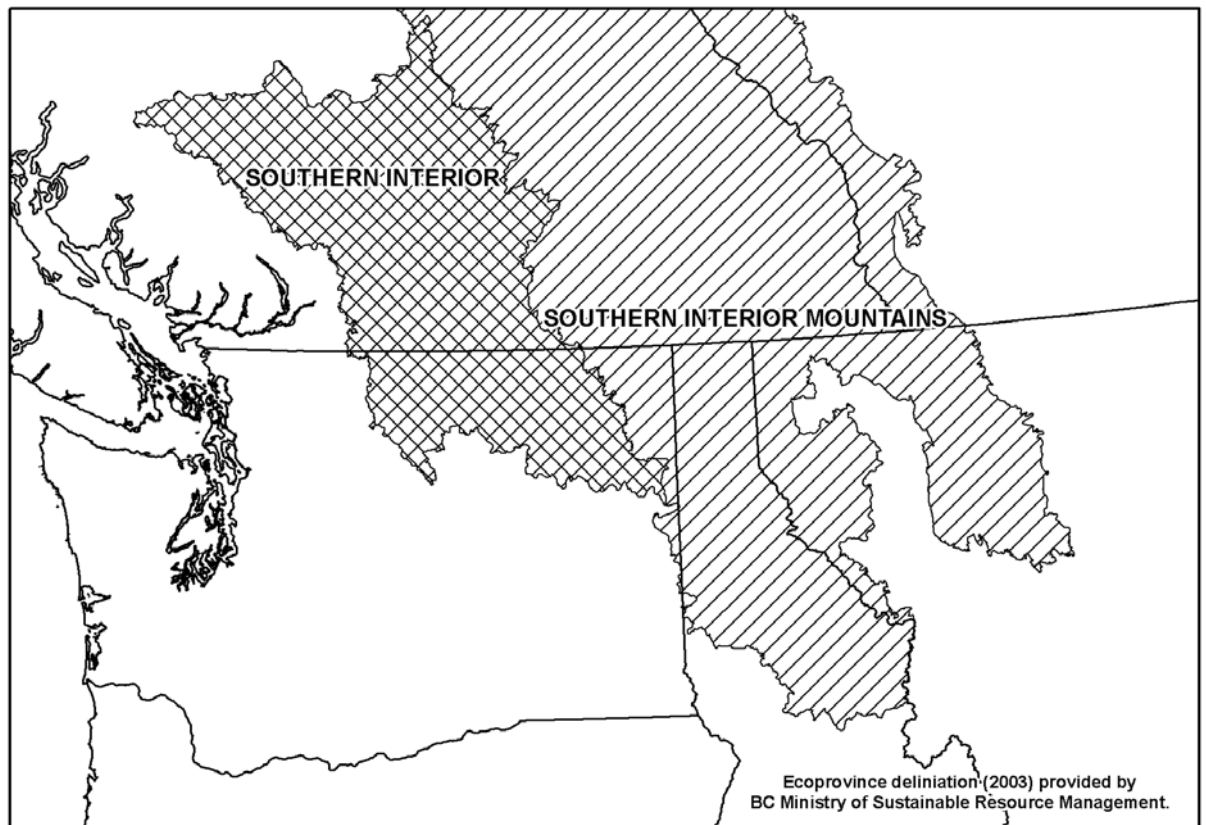
From the lynx distribution map (Figure 1), it appears that Washington lynx habitat contributes to the species range integrity, broadening the habitat "peninsula" that extends into the contiguous United States. Maintaining this habitat connection between the Canadian lynx populations and southern populations may reduce the risk of southern populations becoming extinct due to stochastic events. Future research may reveal the degree to which the persistence of the Washington populations are dependent on the connection to Canada, and what role the habitat in Washington plays as a link between north and south.

The habitat management strategy at ecodivision/ecoprovince scale addresses the assumptions that species that are well-distributed across their historic range are more persistent than species confined to small portions of their range (Assumption A in Section 3.1, Chapter 3) and that population persistence increases when blocks of habitat are interconnected through linkages of suitable habitat (Assumption D in Section 3.1). It also encourages genetic integrity at the species level (Table 4.1). This strategy attempts to:

- Prevent bottlenecks between British Columbia and Washington by minimizing the size of openings created by harvest activities along the US-Canadian border and
- Maintain major lynx travel routes between Washington and British Columbia.

Figure 5. Ecoprovinces of northeastern Washington

(modified from Demarchi and U.S. Forest Service 1994)



ECOPROVINCE GUIDELINES ⁵

- 1. A system of travel routes will be maintained to connect DNR-managed lands with neighboring lynx habitat and to provide access to drainages throughout each Lynx Management Zone (LMZ). Travel routes will follow features that naturally connect landscapes, such as major ridges, saddles, streams and wetland networks. Travel routes will be established in all LAUs regardless of percent of DNR-managed lands.**

Ecoprovinces include landscape features that provide connectivity, and influence lynx home range boundaries and movement patterns (Parker 1981, Parker et al. 1983, Koehler and Aubry 1994). The most important ridges, saddles, rivers, and streams are those that contribute to the overall connectivity within the LMZ. Minor rivers and streams, ridges and saddles, "dead end" ridges and saddles, and duplicate ridges and saddles can be incorporated as possible alternate routes.

The primary habitat concern at this scale is connectivity (Table 4.1). In particular, the travel route system attempts to address:

- adult movements associated with breeding activities,
- juvenile movements associated with dispersal, and
- individual movements, such as those associated with periodic fluctuations in prey density.

The movements are not necessarily associated with the habitat quality of a particular LAU. For example, resident lynx avoid poor habitat when possible, but non-resident lynx might easily cross several LAU's and many different habitat types during long distance dispersal events. For example, lynx have crossed rivers, lakes (Poole et al. 1996, Poole 1997, Mowat et al. 2000) and farmland (Fortin and Huot 1995).

Lynx in north-central Washington often travel on ridges and saddles (Koehler 1990a). On the Loomis State Forest (Okanogan LMZ), 30 out of 100 occurrences (WDFW 2005) were in such areas. Lynx on the Kenai Peninsula, Alaska, similarly traveled on ridges (highest route near forage areas): 45.9 percent of 38 miles (61 km) of lynx tracks followed were on the "top of sharply defined ridges" (Staples 1995). This association to ridges and saddles seems intuitive for a number of reasons:

- 1) These areas may be easier to walk through than lowland forests because tree density is often limited by harsh climatic and/or soil conditions (Kenai Peninsula: these areas were often unburned and so therefore contained mature trees and relatively open forest, Staples 1995).
- 2) It may be easier to spot patches of prey habitat from elevated areas (lynx often sit on ridges and peer down slope into hare habitat, Staples 1995).
- 3) Light conditions may be more advantageous (twilight) for longer periods than in the shaded valleys.

⁵ The guidelines in sections 4.1, 4.2 and 4.4 apply to all LAUs regardless of percentage DNR-managed land per LAU

Also, Staples (1995) suggested that lynx may find fresh carrion by traveling on ridges where they can see ravens and eagles roosting from long distances (0.6 miles or 1 km).

Lynx have also been known to travel and hunt along riparian zones. Historical records from southern areas often report that lynx were observed or taken near rivers, creeks, and their junctions (e.g. Wyoming, Halloran and Blanchard 1954; Oregon, Coggins 1969). Riparian zones may provide travel routes when they are more open than the surrounding matrix (southern Yukon, Mowat and Slough 2003), although in other areas, riparian travel may be minimal (only 1.1 percent of trail segments of tracked Kenai lynx were located in low draws, Staples 1995). Poole et al. (1996) observed lynx along the shores of lakes. Major (1989) observed lynx hunting along riparian zones. Mowat and Slough (2003) described riparian willow stands as important lynx foraging habitat. In southern areas of snowshoe hare range, it is likely that riparian areas become more important habitat elements due to their favorable microclimate and ready supply of browse. Guidebooks from southwestern areas of hare range commonly list riparian and boggy habitats as favored snowshoe hare habitat (Ingles 1965, Kurta 1995). Therefore, maintenance of forested areas along these geographic features may contribute to the connectivity of lynx habitat.

- 1a. Travel routes will be initially developed from topographic maps to provide a network across each LAU regardless of percentage DNR-managed lands. Where available, routes will reflect lynx habitat use patterns as indicated from the WDFW Priority Habitat and Species database (2005). Maps of the currently designated travel routes on DNR-managed lands in each LMZ are presented in Figures 6, 7, 8, 9, and 10. Routes will be field-verified to ensure that the most suitable routes are selected. For example, routes through forested habitats will be preferred where available, to enhance the security of dispersing lynx. Routes may also change as new information on lynx habitat preferences accumulates. As a result the travel routes coverages will be regularly updated.**
- 1b. A special management zone (travel corridor) will straddle the route so that a >330 feet (100m) corridor is available to lynx at all times. On average, the forested zone along the travel route will likely be much wider (Figure 11).**
 - 1b.i. Actual boundaries of the travel corridor along the travel route will reflect the existing contours of the landscape.

Lynx often hunt ridgelines by “zigzagging while moving parallel to the long axis of the terrain feature” (Staples 1995). Riparian routes may be especially important when the routes represent relatively easy and open travel compared to the rest of the forest matrix (Mowat and Slough 2003).

- 1b.ii. Where the travel route is naturally forested, Forested Habitat conditions will be encouraged within the travel corridor.

Given the lynx’s tendency to avoid open areas, forested travel routes are likely preferred. However, considering the distances traveled by dispersing lynx (>300 miles or 500-1,100 km, Slough 1995), it is likely that at least some portions of routes traveled are relatively open. On the Loomis State Forest, the majority of ridge occurrences of lynx were nonetheless within forested areas (77 percent, 23 out of 30 forested). Although open ridges may be important to resident lynx during periods of prey scarcity, as indicated by observations of lynx hunting high elevation open habitats for hoary marmots and

Columbian ground squirrels in Glacier National Park, Montana (Barash 1971), maintaining forested conditions where possible will provide lynx with cover during daily movements and dispersal.

Figure 6. Designated Travel Routes on DNR-managed lands in Okanogan Lynx Management Zone (Loomis State Forest and Loup-Loup block)

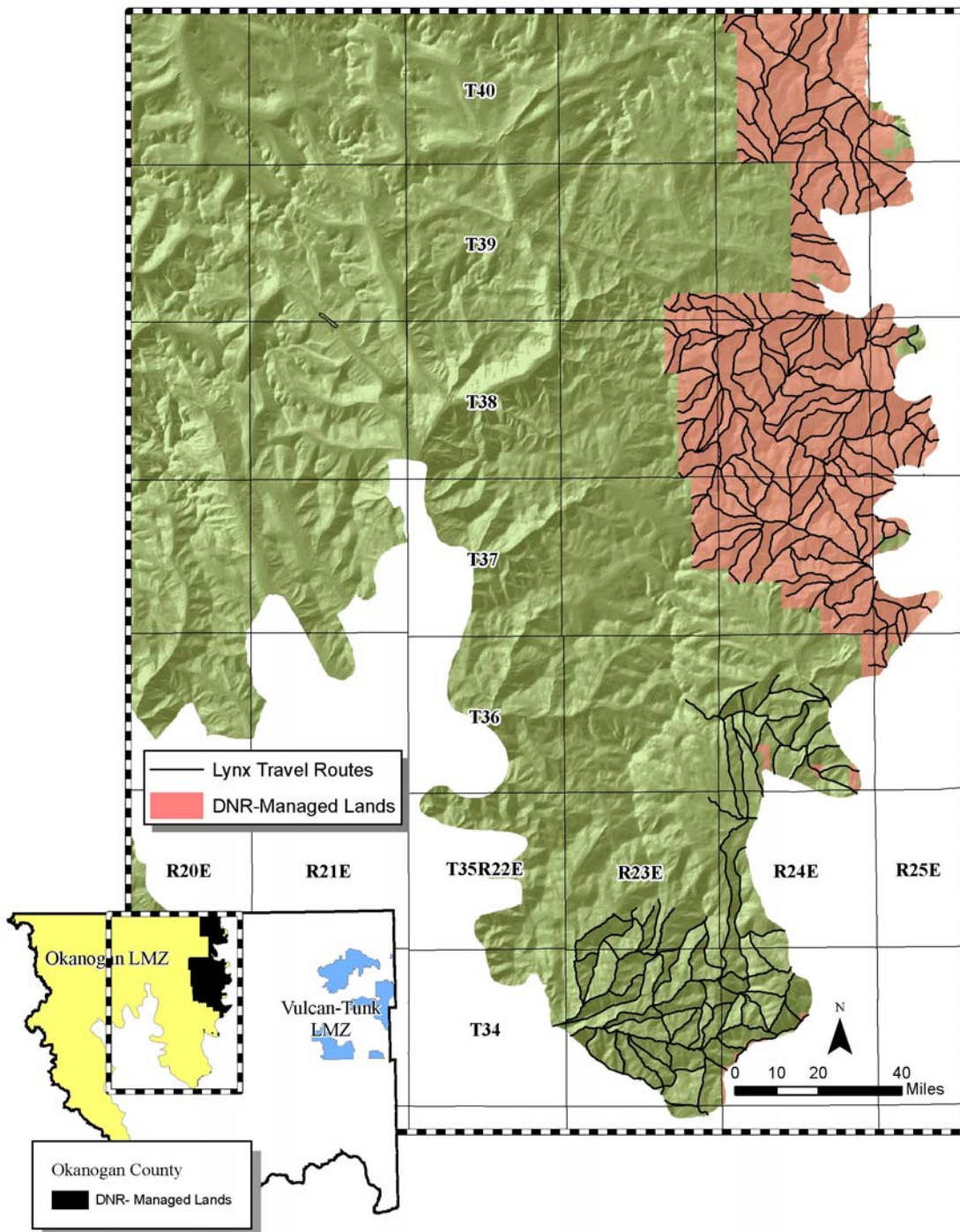


Figure 7. Designated Travel Routes on DNR-managed lands in Little Pend Oreille Lynx Management Zone

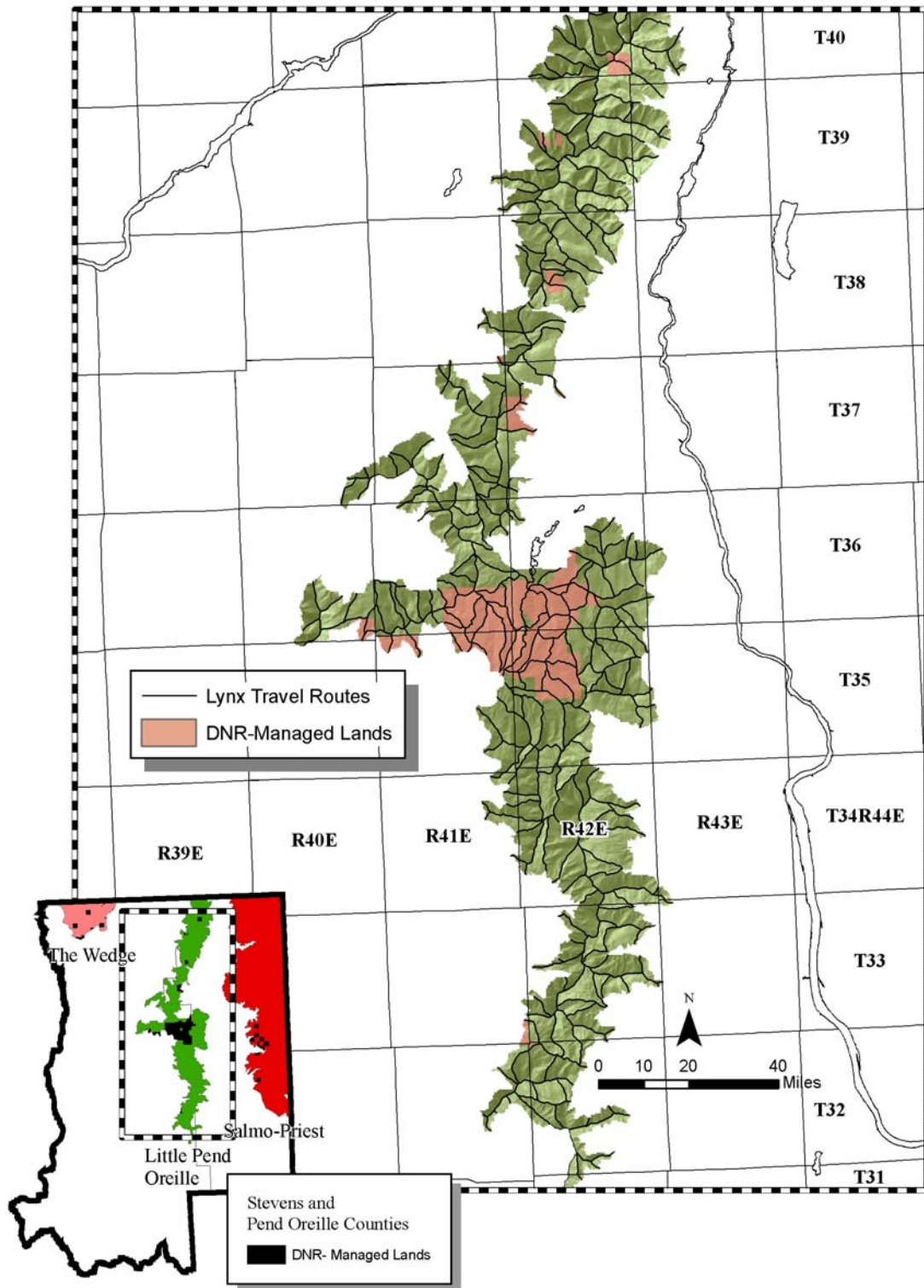


Figure 8. Designated Travel Routes on DNR-managed lands in Salmo -Priest Lynx Management Zone

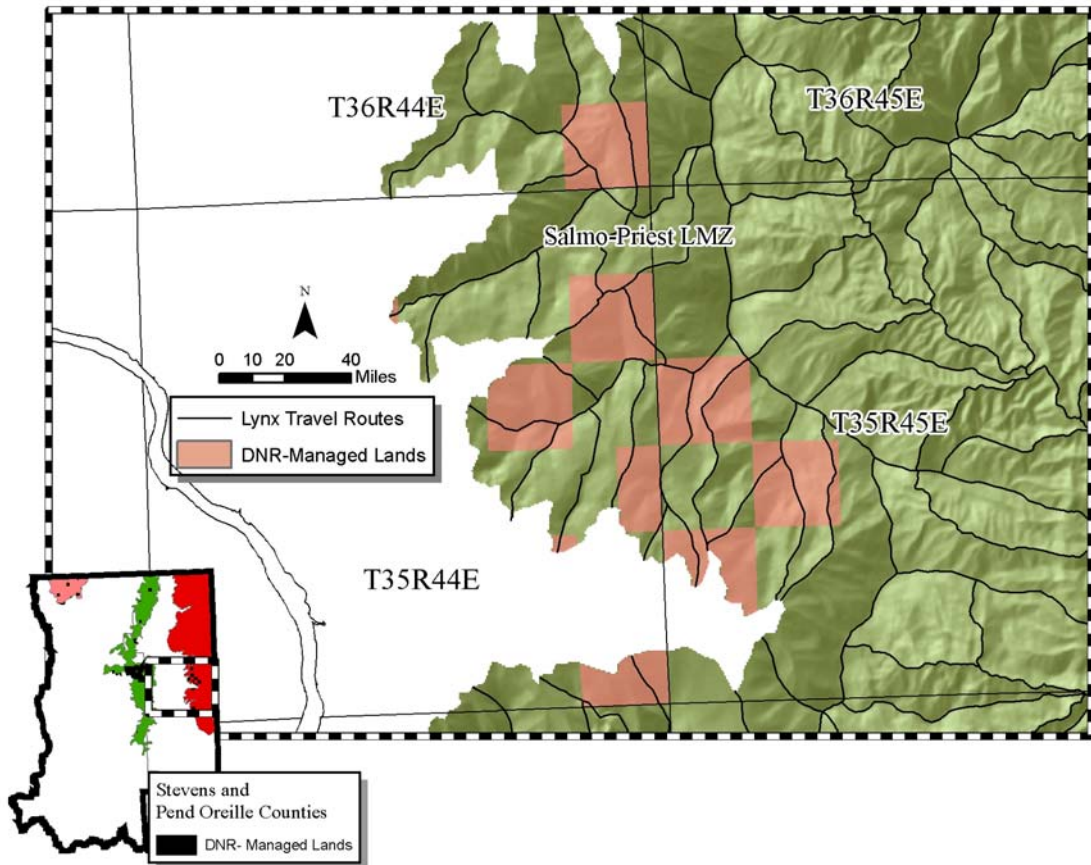


Figure 9. Designated Travel Routes on DNR-managed lands in Vulcan-Tunk, Kettle, and The Wedge Lynx Management Zones

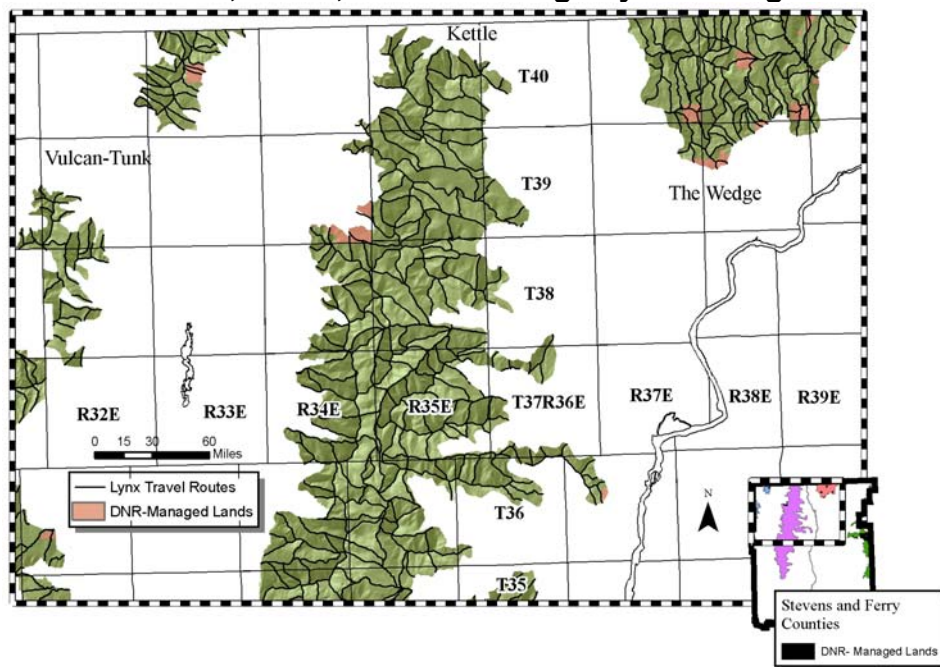


Figure 10. Designated Travel Routes on DNR-managed lands in Okanogan Lynx Management Zone (Chelan County)

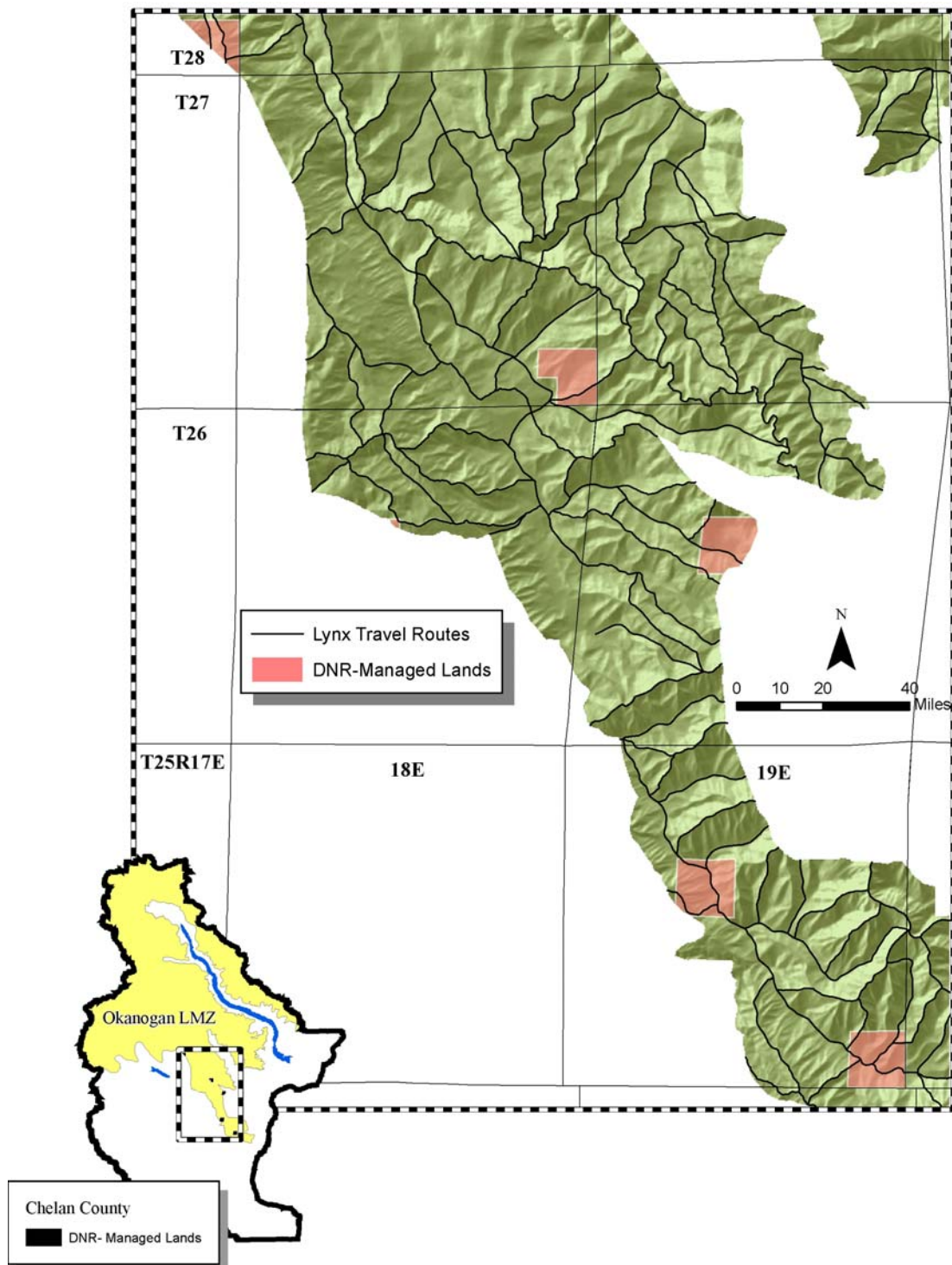
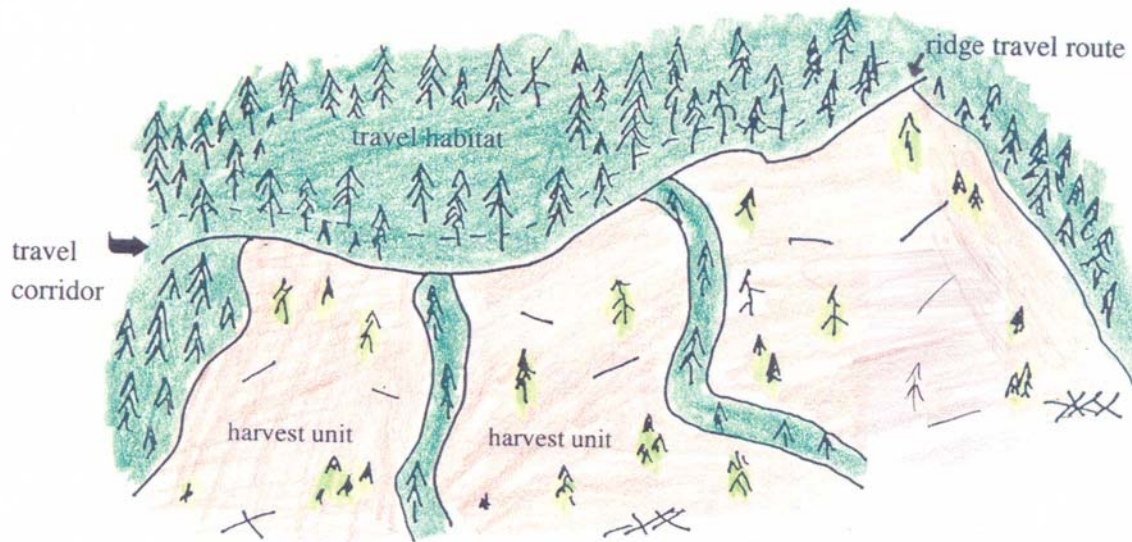
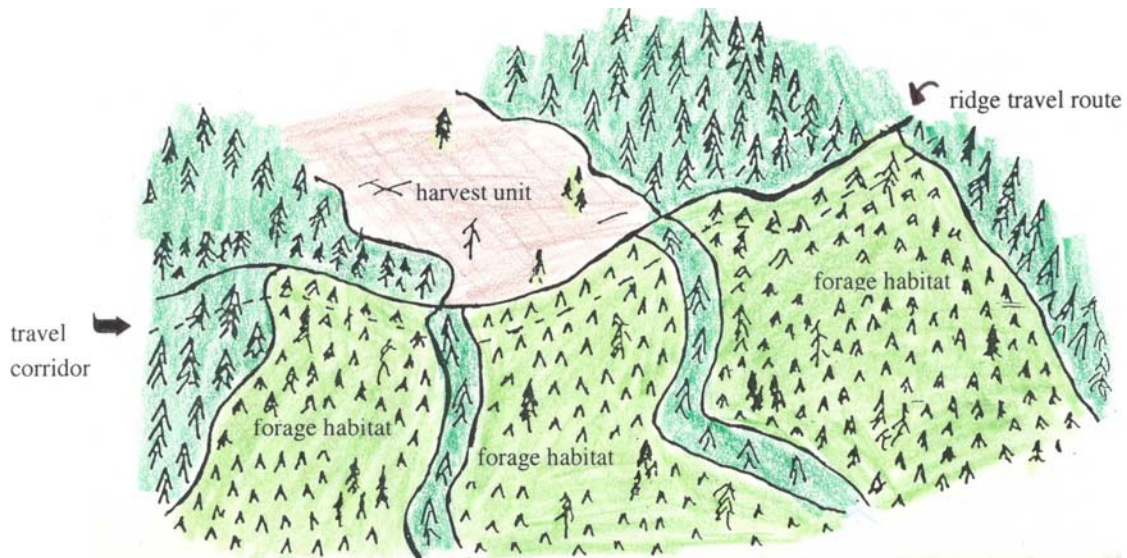


Figure 11. Sample travel route system and management over two phases

a) Sample initial harvest design



b) Second phase (>15 years later)



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- 1b.iii. If harvest activities must occur within the travel corridor along a ridge or saddle travel route, openings will be minimized (less than 330 feet or 100 m wide), techniques to ensure regeneration will be employed, and forested areas will be left on lower slopes and on the other side of the ridge/saddle to provide lynx with alternative travel routes (Figure 11). In situations where there is risk of regeneration failure, the preferred solution will be to avoid harvest within travel corridors. Also, the context of the corridor will be considered, so that an appropriate amount of cover is maintained within the corridor after harvest.

Ridges and saddles are difficult to regenerate due to their increased exposure. Alexander (1973) reported that spruce-fir forests have very high susceptibility to windthrow on saddles and ridges. Gaps on forest ridges should be kept <330 feet (100 m) wide because lynx in north-central Washington avoided crossing open areas >330 feet (Koehler 1990a). However, such gaps at higher elevations are also known to funnel winds, which further increases windthrow risk (Alexander 1973).

If regeneration and blowdown risks are minimal, part of a ridge or saddle could be harvested (Figure 11), if >330 feet (100 m) wide corridor of forested cover is maintained on the opposite side of the ridge/saddle and/or there are alternative routes that lynx could use to travel through the area. In such cases, the context of the travel route will be considered. For example, if the route is situated in an area dominated by Open Areas or Temporary Non-lynx Areas, cover within the travel corridor may be critical. Therefore, harvest that reduces cover will be avoided and the corridor left for lynx will contain the maximum cover available on the site. If the route is situated within Forage Habitat, a more open corridor would be desirable (allowing ease of travel and hunting along the forage habitat edge, such as the unburned remnants within the Kenai Peninsula burn, Staples 1995), and therefore harvest that reduces cover might be planned.

- 1c. If roads must be placed on ridges or saddles due to other priority forest management concerns such as slope stability or water quality, road width will be minimized, vegetative cover will be encouraged on both sides of the roads, sight distance will be reduced (330 feet or 100 m), and/or the roads will be closed as soon as possible, or at least the frequent use of such roads will be discouraged.**

Indirect negative effects of roads on lynx such as poaching, accidental hunting, incidental trapping, vehicle and snowmobile traffic, and competition with other predators that favor road systems may pose a serious threat to lynx (G. Koehler, WDFW; B. Ruedigger, Northern Region, USFS; W. Staples, University of Alaska, Fairbanks pers. commun.; Brocke 1990).

4.2 Lynx Management Zones

The second planning scale uses the six zones of primary lynx range identified by WDFW (Table 3.1, Figure 2). The zones were originally identified by Brittell et al. (1989) and refined by WDW (1993) to reflect surveys, field notes, sightings, trapping records and reports, elevation, and vegetative communities. New information from the USDA Forest Service associated with the federal listing of lynx led to further revision of LMZ boundaries (Stinson 2001).

Although all six LMZ's are considered primary habitat, each zone has a slightly different history and potential as lynx habitat (WDW 1993, Stinson 2001). Accessibility, trapping history, past forest harvest activities, fire suppression practices, size of current lynx population, total area size, vegetative communities, and landscape heterogeneity are some of the variables contributing to the differences in potential between zones.

The management strategy for this scale focuses on maintaining connectivity between sub-populations within Washington (Table 4.1), and addressing assumptions B, D, and E in Section 3.1:

- B. Population persistence increases with the number and size of sub-populations and the size of habitat blocks,
- D. Population persistence increases when blocks of habitat are interconnected through linkages of suitable habitat, and
- E. The persistence of exploited populations increases with a well-distributed network of refuges or safety nets

The habitat management strategy at the Lynx Management Zone scale is:

- Maintain dispersal routes between and within zones (travel routes);
- Arrange harvest activities that result in non-forest patches or other dispersal barriers among watersheds so that connectivity is maintained within each zone;
- Manage human disturbance so that the effectiveness of connectivity measures is maintained.

LYNX MANAGEMENT ZONE GUIDELINES

- 1. Connectivity within LMZs on DNR-managed land will be maintained. Where DNR-managed land is in a critical position (e.g. a narrow constriction within the LMZ, especially along the British Columbia border), forested strips >330 feet (100m) wide will be positioned to facilitate lynx travel through the area, and/or harvest units will be placed to promote connectivity. This may entail keeping harvest units narrow, small, and/or dispersed.**
- 2. Human-related disturbance will be considered in road, harvest, and recreation plans on DNR-managed lynx habitat.**

Because lynx are often described as “curious” (Jackson 1961), “playful” (Saunders 1961, Halfpenny and Biesiot 1986), and perhaps indifferent to human activity (indicated by sightings in garbage dumps, residences, and camps; Halfpenny and Biesiot 1986, van Zyll de Jong 1966, Mech 1973, Staples 1995, Mowat and Slough 1998), they are susceptible to trapping, road kills, and other human-related sources of mortality. Staples (1995) reported that lynx did not flee in 92 out of 105 instances when they were encountered by humans at close range. As emphasized to DNR by T. Bailey (Kenai Natl.

Wildl. Ref., pers. commun.), "I would recommend that every effort be made to minimize human-caused lynx mortality until the prey base and habitat quality significantly improves in your area of concern and you have definite indications of increased kitten production and survival."

- 2a. Strategies to promote lynx security in road and harvest plans may include decommissioning non-essential roads after harvest, placing gates to limit vehicle access, avoiding loop roads, considering roadless logging techniques, limiting sight distances on roads, and maintaining vegetation on the shoulders of roads.**

Lynx use of roads may be mediated by the design of the road and surrounding habitat. For example, Parker (1981) noted that lynx readily followed road edges and forest trails on Cape Breton Island, Nova Scotia. However, Staples (1995) reported that lynx "usually crossed roads at a right angle and did not use or follow roads for long distances" in a Kenai Peninsula study. In Washington, Koehler and Brittell (1990) stated, "Lynx frequently travel along roads with less than 50-foot right-of-way, where adequate cover is present on both sides (of the road)." A re-analysis of the Washington data similarly led to the conclusion that small, narrow forest roads didn't significantly alter lynx habitat use (McKelvey et al. 2000). Brocke (1990) recorded high numbers of road-killed lynx during a reintroduction program in the Adirondacks. Lynx were vulnerable because of the 1) large distances traveled and 2) the attraction of lynx to hares, and hares to roadside vegetation. Staples (1995) also noted that lynx fed on carcasses along roads.

- 2b. No increases in designated or groomed over-the-snow routes or snowmobile play areas will be allowed within lynx geographic range managed by DNR. Maps of the snowmobile routes that currently occur in Loomis State Forest and Little Pend Oreille block are presented in Figures 12 and 13. Closure of some areas that are currently used will be considered if specific areas of increased concern are identified and mutually agreed upon by DNR and the USFWS. Strategies to discourage inappropriate use will include signing of gated systems and placement of physical barriers along the entrance to trail or road systems where appropriate. Additionally, increased organized snowmobile use within the LMZs will not be promoted.**

Although lynx are known to regularly use snowmobile trails for travel (Slough and Mowat 2003), an indirect consequence of snowmobile trails for lynx may be increased competition for prey (Buskirk et al. 2000). Competitive predators that are normally excluded from deep snow habitats where lynx occur can access lynx habitat via compacted snow routes. Coyotes readily use snowshoe hare as prey, and have clear numerical and functional responses to snowshoe hare densities (O'Donoghue et al. 1998). Likewise, snowshoe hare can make a large portion of bobcat diets (e.g. Litvaitis et al. 1986, Parker et al. 1983), and bobcats may displace lynx (Parker et al. 1983). Encounters with other predators (e.g. like cougar and coyote) may also result in direct mortality.

4.3 Lynx Analysis Units

Lynx Analysis Units (LAU) are used to stratify the Lynx Management Zones in order to better evaluate the current and potential habitat conditions and management actions.

LAUs are based roughly on Watershed Administrative Unit (WAU) boundaries while considering lynx home range sizes and occurrence of permanent non-lynx habitats such as rock and ice (Stinson 2001) (see Tables 3.1 and 3.2). The primary use of WAUs is consistent with the observation that lynx home ranges appear to correspond with drainage boundaries in northcentral Washington (Koehler and Aubry 1994). Parker (1981) likewise concluded that lakes and streams contribute to the definition of home range boundaries of lynx on Cape Breton Island, Nova Scotia. The numeration of the LAUs used in this plan and in the monitoring reports is the same as in the Lynx Recovery Plan (Stinson 2001).

The habitat management strategy for this scale focuses on maintaining connectivity between and the integrity of home ranges used by individuals and/or family groups (Table 4.1), and on addressing assumptions C, D, and E (Section 3.1):

- C. Blocks of contiguous habitat in close proximity promote a higher probability of persistence than dispersed blocks of fragmented habitat.
- D. Population persistence increases when blocks of habitat are interconnected through linkages of suitable habitat.
- E. The persistence of exploited populations increases with a well-distributed network of refuges or safety nets.

The habitat management strategy at the LAU scale is:

- Provide a mosaic of successional stages within each LAU; and
- Connect denning and forage areas while avoiding isolation of either with open areas or temporary non-lynx areas.

Figure 12. Snowmobile Trails and Play Areas in Loomis State Forest

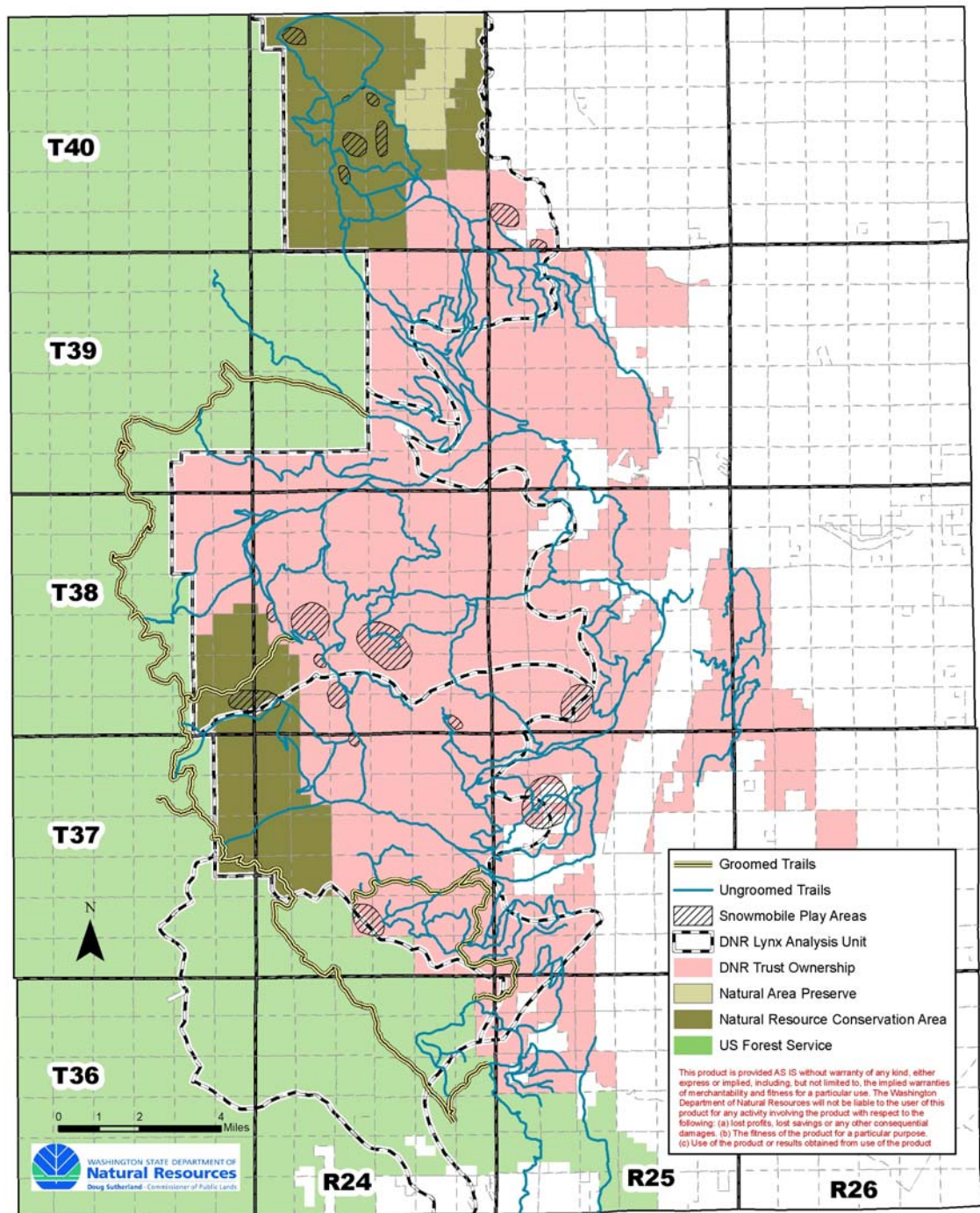
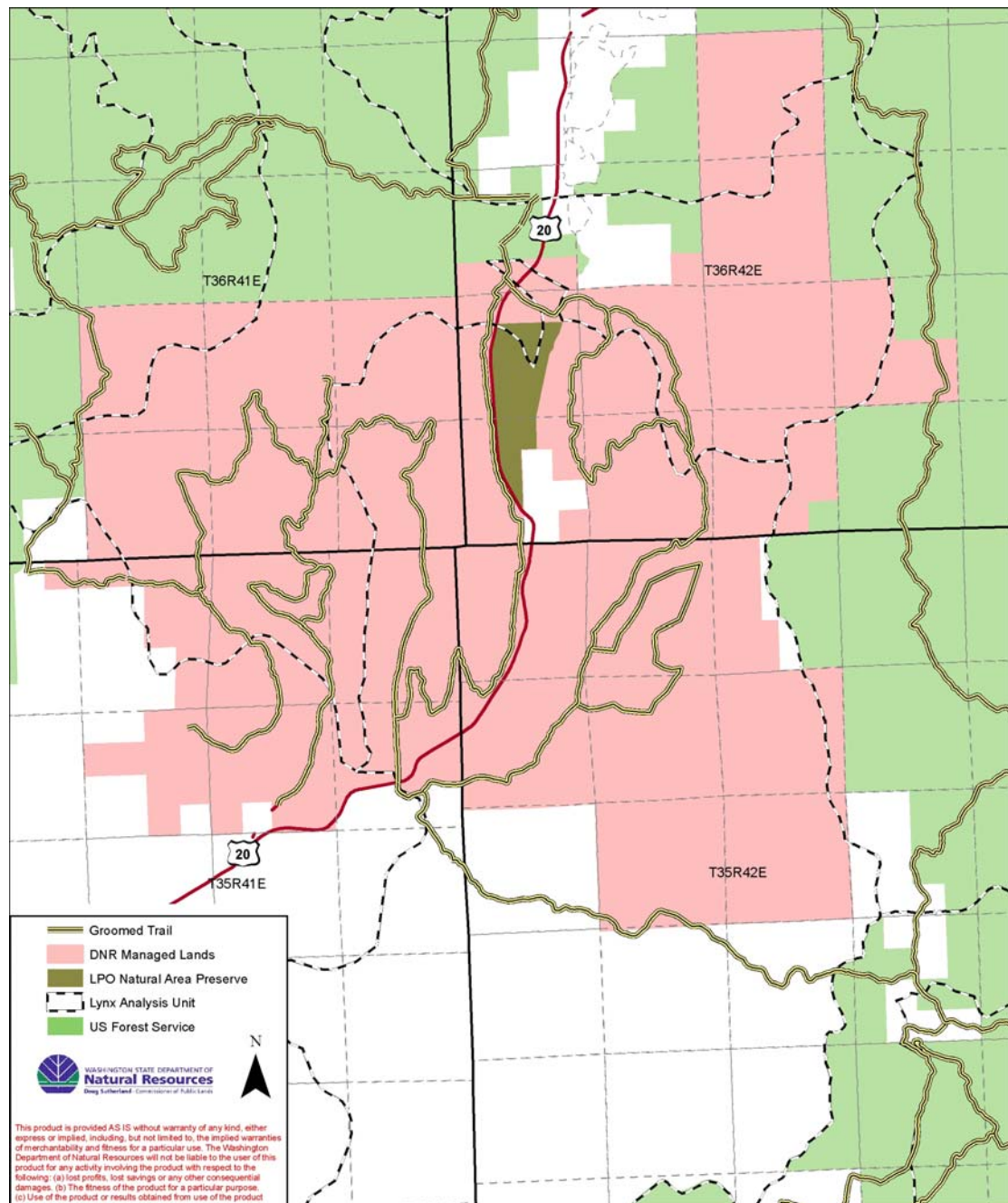


Figure 13. Snowmobile Trails in Little Pend Oreille block



LYNX ANALYSIS UNIT (LAU) GUIDELINES

- The following ratios of lynx habitat components will be maintained in each LAU on DNR-managed lands where DNR manages 20 percent or more of the LAU (Loomis State Forest and Little Pend Oreille Block). See Table 2.1 for definitions of habitat categories.**

Forested Habitat	70% minimum
Forage Habitat	20% minimum
Denning Habitat	10% minimum (including at least 2 den sites/mi ²)
Travel Habitat	40%
Temporary Non-lynx Areas	30% maximum

For example, if a LAU had 30,300 acres, of which 300 acres were meadows, lakes, and talus slopes (i.e. Open Areas), 30,000 acres must be maintained as lynx habitat. This would include at least 21,000 acres of Forested Habitat and no more than 9,000 acres of Temporary Non-lynx Areas. The Forested Habitats would include at least 6,000 acres of Forage Habitat and 3,000 acres of Denning Habitat. The Denning Habitat would be available in at least 94 designated den sites (≥ 5 acres), dispersed as 2 sites for each square mile of the LAU.

The percentage ratios are based on the total acres of potential forested lynx habitat per LAU (total LAU acres minus permanent natural openings and sparsely forested areas). The rationale for the percentage ratio of different habitat types comes from the scientific literature on lynx habitat use (Appendix 3).

Management activities within lynx range, such as maintaining lynx habitat ratios, must be considered "experiments" that include careful planning and monitoring for vegetative response and lynx and hare recovery, and the habitat ratios should be treated as hypotheses. Landscape level research will be required to test the response of lynx to the habitat ratios. This might involve correlating habitat change using GIS to an index of lynx use (i.e. lynx density, home range size, presence of kittens, etc.).

By definition, lynx studies focus on habitats used by lynx, which are often ≥ 80 percent forested. The vital precursors to snowshoe hare habitat, early successional or Temporary Non-lynx Areas, are precluded because they are avoided by lynx for the relatively short duration of the studies that have been conducted. The literature does tell us that within lynx habitat, most of the lynx home ranges probably contain more than 20 percent Open Areas and/or Temporary Non-lynx Areas (Appendix 3). For example, 14 percent of lynx home ranges were categorized as non-forested habitats in northcentral Washington (Brittall et al. 1989). The information from Appendix 3 suggests that if 100 percent of the lynx habitat matrix were to be considered suitable for lynx at all times, the extent of open areas within the matrix should not exceed 20 percent. This implies that LAUs may need to be larger than average lynx home ranges to accommodate the Temporary Non-lynx Areas needed to promote enough Forage Habitat to provide lynx with prey for successful reproduction.

How much Forage Habitat is enough to enable lynx to reproduce successfully?

From the lynx's perspective, the greater the amount of accessible prey a habitat can support, the better the habitat. Likewise, the more of this habitat that is available, the better. Lynx likely encountered wide expanses of high quality habitat in Washington

several decades ago, judging by the wide expanse of relatively even-aged mature forest that currently exists in places like the Loomis State Forest in northcentral Washington. When these forests were younger and supporting high hare densities, lynx perhaps flourished. Estimates of historical forest conditions based on fire history records in the Methow water resource inventory area (WRIA) (Table 4.2) also suggest periodic dominance of prime hare/lynx habitat on the landscape. Of course, historical disturbance regimes may not be a valid base for extrapolation given the social and ecological context currently surrounding forest management within lynx range. Air and water quality, recreation, mineral extraction, livestock grazing, and timber harvesting are social concerns that generally demand gradual change rather than the "boom or bust" cycles of the past.

Table 4.2
Historical landscape composition of watersheds in the Methow River Basin estimated from recent fire history records

(adapted from USFS 1993)

STRUCTURAL STAGE	PRIMARY SPECIES	
	Lodgepole Pine	Engelmann Spruce/ Subalpine Fir
Early even aged, from seedling/sapling to small saw timber, lacking understory	27-45%	15-24%
Middle bilayered with 1) shade tolerant understory species in seedling/sapling or small pole; and 2) saw timber and larger overstory	35-74%	42-89%
Late understory is co-dominant to dominant and occupies all canopy layers as overstory declines; standing and down debris are mostly small to medium sized but some large trees have recently died and are becoming snags	5-11%	10-22%
Old considerable stem decay and top breakage visible in overstory, many seral trees have fallen; the former understory has replaced the original overstory, so that the stand is characterized as having an overmature seral overstory	0.7-1.3%	0.7-1.3%

Even without the above concerns, lynx recovery could not be guaranteed if the historical disturbance regime were applied today. The presence of lynx and other species is the combined result of many variables and circumstances that have likely all changed to

some extent since the last extensive disturbance event. For example, the total land base available for lynx in Washington is decreasing and fragmenting due to human development (e.g. Methow valley) and resource extraction activities (WDW 1993). It is not known how much habitat of what quality is required to maintain a persistent lynx population. Also, development and resource extraction has occurred in neighboring lynx habitat, reducing the potential of these populations to produce dispersers that might historically have repopulated lynx habitat after disturbance. Lastly, formerly remote areas are increasingly susceptible to human disturbance due to the popularity of snowmobiles and all-terrain vehicles. Disturbance within lynx habitat may reduce the quality of current vs. past habitat, which may therefore be reflected in the area's potential to support lynx. Something less drastic than historical disturbance patterns is likely necessary to sustain lynx under today's habitat and social constraints.

Ideally, land managers can achieve some median density of hares (i.e. >1.0 hares/ha) over a median female Washington lynx home range (i.e. 16 square miles) for a median time period (i.e. 4-5 years out of every 8-11 years, Brand et al. 1976). However, the current scientific information on lynx and snowshoe hare habitat relationships is not enough to apply such a strategy. Instead, we must extrapolate from what is known and adapt management strategies to new information. Research in Washington (Koehler 1990a) indicates that landscapes with less than 10 percent Forage Habitat (20-year-old lodgepole pine) may not support successfully reproducing populations of lynx. Similarly, hares occupied only 10-18 percent of available habitat during periods of low hare density in Alberta (Keith 1966, Keith and Windberg 1978) and Alaska (Wolff 1980), and lynx do not reproduce successfully during hare lows. Parker et al. (1983) speculated that lynx landscapes in Nova Scotia should contain 20-25 percent of approximately 20-year-old stands. In this plan, the Forage Habitat is thus set at 20 percent per LAU but includes Forage Habitat in older stands.

Modeling from Okanogan National Forest (Envirodata Systems Inc. 1993, Williams and Lillybridge 1983) suggests that having 20-26 percent of the area in Temporary Non-lynx Areas may result in 26-42 percent Forage Habitat, based on a 70-year rotation without pre-commercial thinning in three of the four habitat types present in the Meadows area. In the fourth group, a 70-year rotation would include 13 percent Temporary Non-lynx Areas and 19 percent Forage Habitat. Limiting the Temporary Non-lynx Area to a maximum of 30 percent per LAU should accommodate some overestimation of forage regeneration that might have resulted from the modeling. This ratio will still promote enough Forage Habitat to provide lynx with prey for successful reproduction. The LAUs managed by DNR are large enough to accommodate a mean lynx home range even with 30 percent Temporary Non-lynx Areas.

How much Denning Habitat is enough?

If Denning Habitat includes both "late" and "old" structural stages, the 10 percent minimum Denning Habitat ratio recommended by WDFW (1996) and used in this plan falls within the ranges historically occurring within the Methow River Basin (Table 4.3). The same is probably true for landscapes in the eastern LMZ, where the cooler, moister forests burn at a longer interval. Even if an entire LAU were subject to wildland fire in a worst-case scenario, the proportion of area left unburned within the fire perimeter might be near 5 percent (using median LAU size of 32 square miles or 82 km², Table 3.2), as extrapolated from a study on large fires in Alberta (Eberhart and Woodard 1987).

Dispersing denning habitat (two den sites per square mile) also increases the probability that some denning opportunities will be available after fire.

- 2. Forest management activities will incorporate interspersions of habitat components within the lynx habitat matrix where DNR manages 20 percent or more of the LAU (Loomis State Forest and Little Pend Oreille Block).**
 - 2a. Harvest activities will be scheduled so that no more than 15 percent of Forested Habitat within a LAU is converted to Temporary Non-lynx Areas per decade. The time frame for calculating the 15 percent threshold will consist of the 10 years prior to the proposed implementation of a project (e.g. timber sale).**
 - 2b. No more than 10 percent of a LAU will be managed at the lower end of the stocking levels that define Forested Habitat (>180 trees per acre or 445 trees/ha) at any one time, and no more than 5 percent of the Lynx Habitat within a LAU will be converted to this minimum condition within a decade.**
 - 2c. Forage Habitat will be connected by travel corridors to Forested Habitat within the LAU and located near Denning Habitat (<3 miles or 4.8 km).**

WDFW (1996) suggested that Forage Habitat should be within 0.5 mile (0.8 km) of denning habitat. Koehler (1990a) hypothesized that the low survival rate of lynx kittens in north-central Washington was related to the large distances that two denning females traveled to reach forage habitat (up to 4.3 miles or 7 km).

- 2d. Timber harvests will be scheduled and designed so that >50 percent of the periphery of Denning Habitat will be bordered by Forested Habitat at all times.**

Because lynx generally do not cross large openings (Koehler et al. 1979, Parker et al. 1983, Murray et al. 1994, Poole 1994, Mowat and Slough 2003), surrounding Denning Habitat with harvested units may temporarily nullify its use by lynx. Brittell et al. (1989) hypothesized that 50 percent of the border of Denning Habitat should be Forested Habitat.

4.4 Ecological Communities

Ecological communities are defined in this Lynx Plan as individual stands of similar vegetation, age, and structure. Activities at the stand-level scale are designed to maintain the function of requisite habitat elements within individual lynx home ranges (Table 4.1).

The habitat management strategies for the ecological community scale are:

- Maintain and/or prolong the use of stands by snowshoe hares, and
- Retain coarse woody debris for denning sites.

ECOLOGICAL COMMUNITY GUIDELINES

- 1. Timber harvest units (Temporary Non-lynx Areas) will be designed to promote swift vegetative regeneration and snowshoe hare/lynx recolonization. This guideline applies to all harvest units, regardless of percentage of DNR-managed land per LAU.**

Snowshoe hare habitat contains two elements at the stand level: 1) food in the form of small diameter stems, needles, branches, and bark of shrubs and conifers and 2) cover in the form of conifers and/or deadfall/slash/blowdown. Traditionally in the literature the definition of Lynx Forage Habitat is simplified to reflect the hare's winter habitat needs.

- 1a. Harvest unit size will reflect the regeneration capacity of the site and contribute to a diverse mosaic of habitat patches available to snowshoe hare and lynx. Units will be designed so that Temporary Non-lynx Areas never exceed 200 contiguous acres (81 ha). Where DNR manages more than 20 percent of a LAU, the total Temporary Non-lynx Area per LAU on DNR-managed lands is limited to 30 percent.**

Conroy et al. (1979) suggested that the distance from newly cleared harvest units to cover should not exceed 656 to 1,312 feet (200-400 m) to benefit snowshoe hare and regeneration. Koehler and Brittell (1990) recommended unit size less than 40 acres (16.2 ha) to encourage natural regeneration. However, regeneration is site-specific, and a variety of harvest unit sizes might provide a better mosaic of habitat for lynx and hare, due to the effects of patch size and spatial relationships on hare densities. For example, small populations within 12 to 17-acre (5-7 ha) sites did not persist as long as larger populations in 56 to 69-acre (23-28 ha) sites in Wisconsin (Keith et al. 1993). Thomas et al. (1998) also found higher densities of hares in large patches than small patches in Colville National Forest. It is possible that the interior of larger patches provides a refuge for hares, enabling them to persist through periods of intense predation (see "1b" below). Small units also necessitate frequent human disturbance and road access, both of which are thought to be detrimental to lynx persistence (Koehler and Brittell 1990; Guideline 5). In her research in Okanogan National Forest, Walker (2005) found that relative hare densities were negatively related to the amount of open-structured habitat types, and positively correlated with the amount of boreal forest within 300 m of a patch of dense forest.

In recent history (early 20th century), the mean patch size of lodgepole pine in age classes preferred by hare and lynx averaged 155-185 acres (63-75 ha) in the Methow Valley (Lemkuhl et al. 1994). Areas up to 170 acres (69 ha) - median of the Methow range - in similar age classes might be therefore appropriate for the lynx landscape, if the large size of the unit didn't impair regeneration within the stand. Adding for variability (only means were reported), up to 200 acres (81 ha) is a hypothesized upper limit, provided that these larger units do not dominate the landscape. Occasional larger sized patches might benefit lynx indirectly by reducing the traffic on roads and the total amount of roads needed, as well as addressing the prey vulnerability/abundance issue.

Given the uncertainties and issues detailed above, a combination approach to unit sizes is appropriate. Such an approach offers opportunity for recovery if the management experiment fails. For example, the combination might include: 1) larger regenerating

stands (e.g. 100 acres or 40 ha), so that hare have refugia and a chance to reach higher numbers, and 2) similarly sized areas (e.g. 100 acres) with small, grouped harvest units (20-40 acres or 8-16 ha) separated by forested corridors, to favor hare vulnerability for lynx.

- 1b. Harvest unit shape will enhance the regeneration potential of the unit and provide a diversity of forage and browse opportunities for the lynx and hare. This may include periodic constrictions of 330 feet (100 m) or less within harvest units to provide lynx with opportunities to cross larger units (Koehler and Brittell 1990).**

A combination of unit shapes is recommended. Research in other southern areas of snowshoe hare range (i.e. Wisconsin: Buehler and Keith 1982, Sievert and Keith 1985) suggests that hares may be most vulnerable along stand edges. Lynx are capable of hunting both within and along the edges of thick stands that hare prefer (Murray et al. 1994), but coyotes (Theberge and Wedeles 1989) and avian predators mostly hunt the edges. Maximizing edge may therefore increase the vulnerability of hares to the latter, at a net cost of hares needed by the lynx. Also, a policy of maximizing edge will increase the amount of browse that snowshoe hares must share with browse competitors such as domestic sheep (Dodds 1960), moose (Dodds 1960, Oldemeyer 1983), white-tailed deer (Bookhout 1965), and perhaps domestic cattle (suggested for other leporids by MacCracken and Hansen 1984). Snowshoe hare browse grass and other herbaceous vegetation during the snow-free season (Brooks 1955, Severaid in de Vos 1964, Wolff 1980, Hik 1994, Nams et al. 1996). Because large ungulates might have less influence on the interior of a dense stand, relatively more forage would be available to hares if the area to perimeter ratio were larger.

If enough hares and hare browse are available in the landscape, both the competition for browse (hare vs. ungulate) and the competition for prey (lynx vs. other predators) may be ameliorated. For example, Witmer and DeCalesta (1986) attributed the coexistence of bobcat and coyotes in a managed forest to high prey abundance (both species consumed mainly mountain beaver). O'Donoghue et al. (1998) found no evidence for interference competition when hares were at peak densities in the Yukon.

- 1c. Harvest unit design will enhance the regeneration potential of the site and provide opportunities for rapid hare recolonization by containing clumps or islands of remnant vegetation and/or woody debris.**

Standing trees or snags, shrubs, and slash can be important sources of seed within lodgepole pine harvest units (Lotan and Perry 1983). Leaving such structure behind may mimic moderate intensity wildfire that generates lynx forage habitat.

Hare use within clearcuts was higher than expected in uncut, non-merchantable clumps within clearcuts such as islands, riparian zone buffers, and wetland buffers (Monthey 1986). Compared with sites not used by hares, occupied managed forest habitat had more cover by stumps and slash (Scott and Yahner 1989). Hares used brush piles in New York where conifers were absent or sparse (Richmond and Chien 1976). Old burns with cover in the form of brush and fallen woody debris can also be used extensively (Grange 1932). In Montana, dense clumps of Douglas fir within relatively open ponderosa pine forests

were used by hares (Adams 1959). In summary, the less barren a regenerating stand is, the more hospitable it may be to lynx and hare. Also, the larger the unit, the more important such structures may become. The number of unburned islands within a burned area increases with fire size, and the disturbed area has more irregular shape and edge with increasing fire size in Alberta (Eberhart and Woodard 1987).

Remnant material may also provide a lingering benefit of within-stand diversity that is characteristic of prime hare habitat. Interspersion of vegetation/slash is likely better for hares than uniform forests (Morse 1939, Conroy et al. 1979, Ferron and Oulette 1992). Also, lynx visually search for prey from piles of slash and snow (i.e. forming over remnant vegetation and debris) on the Kenai Peninsula, Alaska (Staples 1995).

- 1d. Forest regeneration techniques will reflect the unit's potential to produce quality hare habitat (unit quality, according to vegetation association) and may involve use of fire or soil scarification techniques.**

Not all forested sites may be able to attain stem densities preferred by hares. For example, the modeling (Envirodata Systems, Inc. 1993) rated lodgepole pine stands of ABLA2/VACCI, ABLA2/LIBOL, and ABLA2/CARU associations (for an explanation of plant association abbreviations see Appendix 4) as having higher potential to produce lynx habitat than ABLA2/VASC/CARU, ABLA2/VASC, and ABLA2/RHAL associations (Appendix 2, Table A2.13). Also, regeneration harvest alone or regeneration harvest followed by slash burning may not mimic fire in regenerating lodgepole pine stands. By leaving the soil less physically disturbed, opening serotinous cones, and providing many snags that shade new seedlings from the sun and protect them from the frost, regeneration after fires may be excessive whereas after harvest, regeneration may be poor or absent (Okanogan Area, ABLA2/VASC associations, Williams and Lillybridge 1983).

- 1e. To minimize potential impacts to snowshoe hare/lynx habitat from livestock grazing, DNR will continue to implement grazing guidelines and requirements that move the resources toward the conditions described by HB1309 Ecosystem Standards for State-owned Agricultural and Grazing Land.**

Additional grazing guidelines for the Loomis State Forest are found in the Loomis Landscape Plan (1996b, p. 50), including:

- 1. limitations of grazing pasture units no more than half the active growth period where geographically feasible;**
- 2. limitations on the quantity of top growth to be grazed; use of native plant species where possible; control and minimization of the spread of noxious weeds;**
- 3. improvements of livestock distribution through multiple techniques, deferment of livestock grazing on burned areas for one year after a fire, depending on fire intensity; and**
- 4. evaluating and monitoring cattle access to Riparian Management Zone's after timber harvest and providing for fencing or slash barriers where necessary to prevent cattle induced stream bank damage.**

Within DNR-managed land covered by the Lynx Plan, 105,139 acres are subject to active grazing leases or permit ranges. Approximately 90,633 acres of those lands grazed are in the Loomis State Forest. Ninety eight percent of the total acreage is under eight Grazing Permits (seven in the Loomis State Forest and one in the Little Pend Oreille block). Resource Management Plans have been developed for all DNR-managed lands that are

grazed, including lynx habitat. DNR works with other natural resource agencies, adjacent land managers, and other interests to implement Resource Management Plans on permit ranges. The Resource Management Plans are designed to maintain the native plant community's structural complexity, vegetative cover, and plant species diversity that approximate the site potential. The plans are not designed to address the specific needs of individual species, including lynx.

No studies have directly addressed overlap between the diets of domestic cattle and snowshoe hare. However Johnson (1979) found a 51 percent overlap between cattle and black-tailed jackrabbits, and MacCracken and Hansen (1989) found that in Southeastern Idaho, cattle density can limit the density of jackrabbits and cottontails as a result of exploitative competition. Cattle stocking rates are apparently related to browsing damage on lodgepole pine seedlings, and increased cattle grazing pressure results in increased trampling damage to regenerating tree seedlings (>10 percent of sample trees; Pitt et al. 1998). Although trampling damage may be negligible if cattle movement and densities are adequately controlled (McLean and Clark 1980), it can be substantial if the grazing period is too long.

- 2. Quality snowshoe hare habitat, located within lynx Forage Habitat, will be maintained by providing adequate horizontal cover above average snow depth. Horizontal cover measurements will be taken in the 1.5-2.0 meter range of a vegetation profile board at 10 sample points along a transect. Four measurements will be taken from each sample point in the four cardinal directions viewed from 45 feet (15 m), resulting in a total of 40 measurements. Only those stands that receive no more than four "zero" scores (no cover) over the 40 readings will be considered Forage Habitat (for the definition of Forage Habitat, see Appendix 2, Section 7).**

Adams (1959) qualitatively asserted the positive relationship between cover density and hare density in Montana. Cover densities >40 percent within 3-5 feet (1-1.5 m) explained 85 percent of winter hare habitat use in northern Utah (Wolfe et al. 1982). "Refuges" with cover densities of approximately 75 percent (up to 12 feet or 4 m tall) were used by hares in winter near Fairbanks, Alaska (Wolff 1980). Cover 3-10 feet (1-3 m) above ground in the form of 50-60 percent conifer foliage cover values was identified as the single most important factor influencing snowshoe hare distribution in New Brunswick (Parker 1986). All of the above authors observed seasonal shifts in habitat use by hares to relatively more open (but still with cover) areas outside of winter. Orr and Dodds (1982) found lower hare densities in forests with trees >40 feet (12 m) tall and canopy closures of 60 percent (Nova Scotia). Adams (1959) observed that stands that were too dense to allow growth of forbs on the ground were less used than less dense stands but both categories were used more than open stands (Montana).

Although stem density and horizontal cover are correlated, the relationship is not precise (Swayze 1995), and the relation between the hares and stem density is not as clear as that of horizontal cover density (Litvaitis et al. 1985b). Nonetheless, stem densities reported in the literature are consistent across the hare's range: stands with approximately 6,000-14,000 stems/acre were intensively used by hares, especially in winter (Brocke 1975; Wolff 1980; Sullivan and Sullivan 1982, 1983; Litvaitis et al. 1985a,b; Monthey 1986; Koehler 1990b; Swayze 1995). In the Methow Basin, stems within hare's winter reach (max. lowest live limb = 3.3 feet or 1m) were still used extensively at these high stem densities

(Swayze 1995). According to Walker (2005), the density of saplings and medium-sized trees were the best predictors of snowshoe hare density at the stand level. In Idaho, Wirsing et al. (2002) found low snowshoe hare densities in study areas with less than 40 percent horizontal cover.

The critical characteristic of vegetation height within Forage Habitat is derived from the hare's limited ability to reach for browse above ground or snow level. Browse heights reported for snowshoe hare are generally within two to three feet (60-85 cm) of the average snow level (de Vos 1964, Brocke 1975, Grigal and Moody 1980, Parker 1986, Pease et al. 1979). Higher browse may be available to hares as the weight of winter snow depresses branches (de Vos 1964).

- 2a. Browse and tree cover will be provided by species preferred by hares (according to the vegetative association), if preferred species are identified for the area. Otherwise, forest regeneration efforts will focus on creating the structure (cover density) preferred by hares, rather than the tree species (Ferron and Oulett 1992).**

In northcentral Washington, Koehler (1990b) observed the highest densities of hares in 20-year old lodgepole pine stands, but no other forest types were sampled in that age range. Lynx tracking data in northern Washington show that Engleman spruce/subalpine fire forest types are important to and selected by lynx (Maletzke 2004). The author speculates that perhaps snowshoe hares are as abundant in Engleman spruce/subalpine fire forest as they are in lodgepole pine stands or that the stand structure of the former type results in higher predation success. However, high hare densities reported in dense lodgepole pine stands in the following locations also implicate the importance of lodgepole pine as snowshoe hare habitat: British Columbia (Sullivan and Sullivan 1982, 1983), Montana (Koehler et al. 1979), and Yukon (Slough and Ward 1990). Also, de Vos (1964) suggested that pines are preferred browse. Other coniferous species may provide snowshoe hare habitat, especially in the eastern-most zones of lynx habitat in Washington (i.e. western hemlock and western red cedar). This probability is supported by the broad array of conifer species used by hares in other regions: Douglas fir (Bull Island, Flathead Lake, Montana, Adams 1959); red spruce (West Virginia, Brooks 1955; New Brunswick, Parker 1984); jack pine and black spruce (Hubbard County, northcentral Minnesota, Pietz and Tester 1983); balsam fir, eastern arborvitae cedar, and white spruce (Itasca County, northcentral Minnesota, Fuller and Heisey 1986); subalpine fir (48 percent of total collected pellets) and Douglas fir (28 percent) (northern Utah, Wolfe et al. 1982); subalpine fir (26 pellets/plot) and lodgepole pine (19 pellets/plot) (Utah, Clark (1973) cited in Dolbeer and Clark 1975); and mixed Engelmann spruce and subalpine fir forests and mixed spruce-fir-lodgepole pine forests (Colorado, Dolbeer and Clark 1975).

- 2b. Thinning, partial harvests, or other treatments to create forage opportunities in Travel Habitat will be considered. However, pre-commercial thinning will be delayed in Lynx Habitat until self-pruning processes have excluded most live lower limbs within 2 feet of the average snow pack level. The two exceptions are: stands included in an experimental program and stands within DNR's Pend Orielle seed orchard (approximately 40 acres).**

The effects of pre-commercial thinning on snowshoe hare habitat are being studied by the Rocky Mountain Experimental Station in Montana and the Forest Service in Oregon (Bull et al. 2005) among others. According to Sullivan and Sullivan (1988) although thinning in Forage Habitat may temporarily reduce the quality of a stand as lynx habitat, it may have long-term benefits by prolonging forage conditions within the stand. For example, thinning can release understory shrubs preferred by hares (*Salix spp.*) and make

trees within the unit more accessible to hares by decreasing the distance of the lowest branch to the ground (Interagency Lynx Committee 1999; C. Lee, USFWS, pers. commun. and unpubl. field trip notes). Bull et al. (2005) research suggests that pre-commercial thinning of lodgepole pine in 10-m-wide patch cuts dispersed across less than 50 percent of a stand increased the abundance of snowshoe hares in the short term compared to traditional thinning and corridor thinning. Given the presumed limited availability of high-quality forage habitat currently present on DNR-managed lands it is preferable to take a conservative approach until more scientific data on the effects of pre-commercial thinning on snowshoe hare habitat is available.

2c. Riparian vegetation, such as willow thickets along wetlands, will be included as Forage Habitat.

Mowat and Slough (2003) observed high densities of snowshoe hare within dense willow stands along creeks and lake edges, and lynx use of these habitats. Willow-alder thickets were thought to provide refuge for hares from avian predators in interior Alaska (Wolff 1980). Alder swamps provided good hare habitat in Minnesota (Green and Evans 1940) and Michigan (Bookhout 1965). Lynx were observed hunting along the edges of dense riparian willow (Major 1989).

3. To ensure that potential denning structure is available across the landscape, at least two den sites per square mile will be provided in all Lynx Management Zones (LMZs) where DNR manages at least one square mile.

Den sites will be at least five acres (2 ha), but many den sites will be located within larger areas of Denning Habitat in LAUs where DNR manages at least 20 percent of the area (see Guideline 4 below). According to this “best available” strategy, den sites will still be identified if site conditions do not match preferred structures, as indicated in the selection criteria.

Dispersion of Denning Habitat is believed to be important to lynx (use of more than one den site noted by Slough (1999), Koehler (1990a), and Koehler and Aubry (1994). Dispersing a number of suitable den sites within a short radius of each other may increase the survival of kittens because the female will be able to minimize the time the kittens must be left unprotected while she hunts for prey and also minimizes the chance that all denning habitat would be eliminated during a fire event. The risk from fire may also be reduced by selection of sites with northerly aspects and low slope positions (Camp et al. 1997).

Priority for den site selection will be as follows:

- 3a. First priority for designation will be known lynx den sites.**
- 3b. Second priority sites will be identified in pre-sale harvest unit inventories.**

Den sites will have denning structure, defined as deadfall with large-end diameters of 6 inches (15 cm) or greater (including root wads), layered such that there is an average of >0.8 logs/3.3 feet (> 1 log/m) that are 1-4 feet (0.3-1.2 m) off the ground over a 150-foot (50 m) transect. Examples of preferred

denning structure are depicted in the Lynx Habitat Field Reference Notebook (Interagency Lynx Committee 1999). Sites with larger deadfall diameters will be selected over sites with smaller deadfall diameters (Lloyd 1999), and sites will be preferred where deadfall covers at least 75 percent of a five-acre patch.

Koehler (1990a) described four dens (two each by two females) in north-central Washington as containing an average of 40 logs per 150 feet (50 m) of sample transect. Koehler and Aubry (1994) later described the debris as >1 log/3.3 feet (1 log/m), 1-4 feet (0.3-1.2 m) above ground. WDFW (1996) recommended logs at least 6 inches (15 cm) in diameter. Larger diameter logs likely have higher value as denning structure because they decay slower and provide a greater amount of sturdier cover. Windfall, insect or disease die-offs, and fire have historically been the source of this debris. This structure may be the most important characteristic of Denning Habitat, as suggested by Koehler and Brittell (1990) and discussed in Section 2.2 earlier. However, the den sites in Washington were in ≥ 250 -year-old Engelmann spruce/subalpine fir/lodgepole pine stands on N or NE aspects (Koehler 1990a).

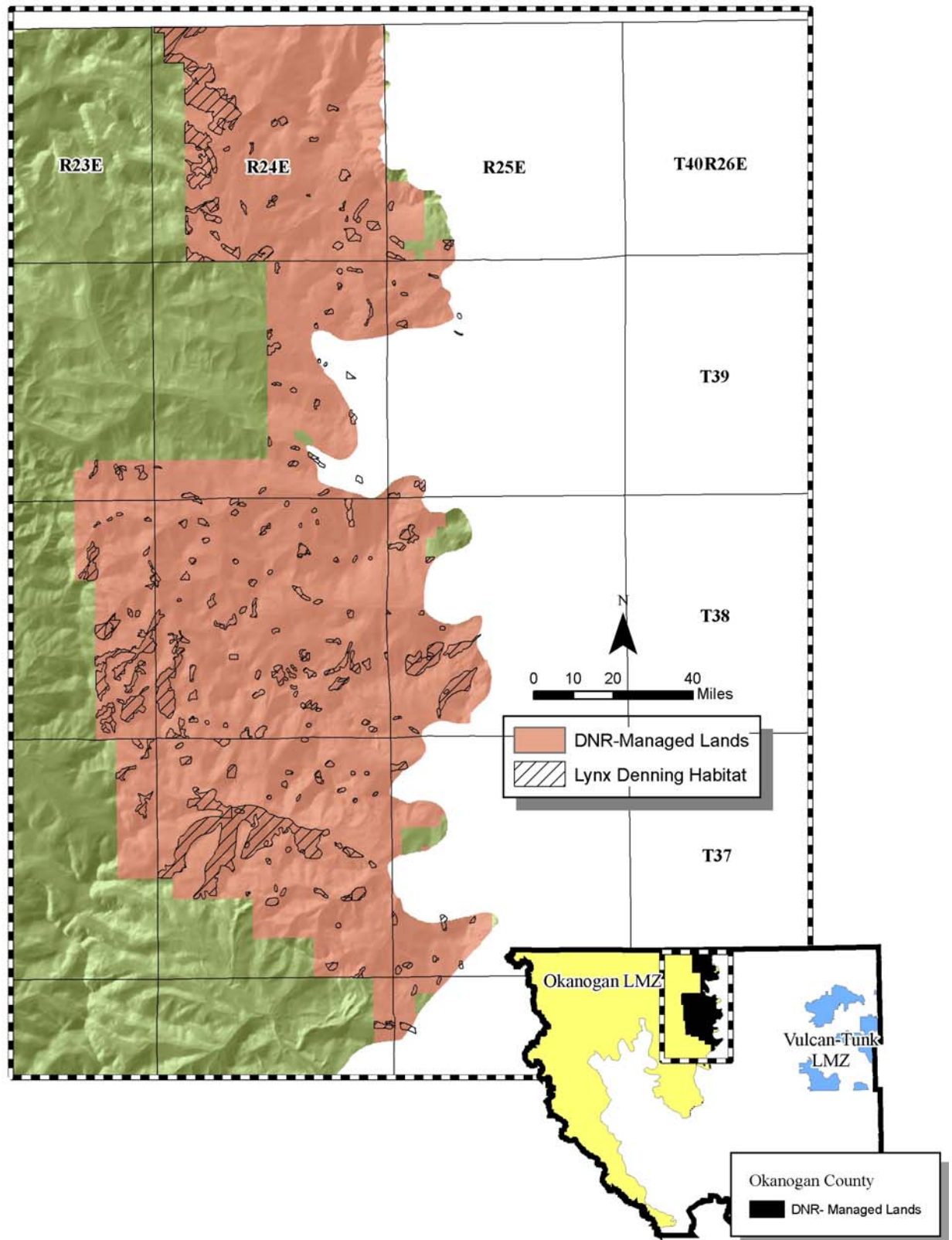
- 3c. Den sites within Denning Habitat will be preferred over den sites in other habitat types, following priorities listed in the Ecological Communities guideline 4.b. below. The priority of den sites within other types of habitats are as follows: Travel, Forage, and Temporary Non-lynx Areas.**
- 3d. If no existing denning structure can be found, sites with insect or disease mortality or other potential to provide future denning structure via windthrow will be selected. Alternatively, den sites may be artificially constructed. DNR's region biologist will coordinate with WDFW to survey existing den sites and recommend details of artificial den size and structure. In addition:**
 - 3d.i. Logs used for artificial den site creation will reflect what is available on the site and within each section. If logs >6 inches (15cm) are available within a LAU, den site creation will be planned there. However, not all Denning Habitat that lynx occupy support such diameters. If no large diameter logs are available, log sizes used will reflect the largest available.**
 - 3d.ii. The maximum number of jack-strawed down logs possible will be used to create artificial den sites, given regeneration concerns and log availability.**
 - 3d.iii. Sites on north or northeast aspects will be selected over other aspects, if available.**
 - 3d.iv. Sites with mesic plant associations will be selected, if present.**
- 3e. In the case of a large fire or other catastrophic event (defined as 640 acres (260 ha) or more where 40 percent of the trees or volume die or are at risk within 12 months of the event), designated den sites will still encompass the best available per section; that is, minimum 5-acre (2 ha) patches with standing trees, snags, and woody debris maintained for denning habitat recruitment.**
- 4. Denning Habitat identified for the purpose of meeting the denning habitat area requirement (10 percent per LAU minimum, as described in LAU guideline 2b), where DNR manages 20 percent or more of a LAU, will be selected according to the criteria below. Map of the designated Denning Habitat in Loomis State Forest is presented in**

Figure 14. Denning Habitat designation in the Little Pend Oreille block is in process and a map will be available in the summer of 2006. Denning Habitat designation may change as habitat develops over time or as field verification finds a better quality habitat available. As a result, the Denning Habitat coverages will be regularly updated. Should some of the 10 percent be compromised by fire, pathogens, or other unforeseen events, new Denning Habitat will be added as indicated in Appendix 7.

The threatened status of lynx in Washington and the lack of information demand a conservative approach to Denning Habitat management. The difficulty is that this habitat type takes a relatively long time to develop. If the extent of these older forests is substantially reduced in the landscape and future research reveals that this habitat is more important than originally suspected, it may take many decades before the habitat is again suitable for lynx. The philosophy in this habitat management plan is therefore to designate Denning Habitat based on what is known about lynx dens in Washington, and to make adjustments in the future as necessary. Denning Habitat may also benefit lynx by providing thermoregulatory cover and/or alternative prey opportunities.

- 4a. First priority Denning Habitat will contain known lynx den sites. WDFW and USFWS will provide the locations of known lynx dens to ensure that stands which currently or historically supported lynx dens are protected.**
- 4b. Second priority Denning Habitat will be identified in pre-sale harvest unit Inventories. Denning Habitat will contain suitable denning structure, defined as deadfall with large-end diameters of 6 inches (15 cm) or greater (including root wads), layered such that there is an average of >0.8 logs/yard (1 log/m) over a 150 foot (50 m) transect that are 1-4 feet (0.3-1.2 m) off the ground. Stands with more than one potential den site will receive highest priority. Preference will be given to stands as indicated below:**
 - 4b.i. mature to over-mature stands of spruce/fir or a similar mesic association with north or northeast aspects
 - 4b.ii. stands that have mesic associations with other aspects and/or low slope positions
 - 4b.iii. stands that have mature to over-mature overstories without mesic associations
 - 4b.iv. stands with higher elevation, given similarities in structure, age, and aspect.
- 4c. If no existing den sites can be found, the Denning Habitat area requirement will be met with stands that have the potential to become Denning Habitat such as those with insect and/or disease mortality or other potential to provide future denning structure via windthrow.**
- 4d. In the case of a large fire or other catastrophic event (defined as 640 acres (260 ha) or more where 40 percent of the trees or volume die or are at risk within 12 months of the event), designated den sites will still encompass the best available per section; that is, 5-acre (2 ha) patches with standing trees, snags, and woody debris maintained for Denning Habitat recruitment.**

Figure 14. Designated Denning Habitat in Loomis State Forest



5. Potential human disturbance to den sites and Denning Habitat will be minimized.

WDFW (1996) recommended that harvest activity and use of motorized equipment be excluded within 0.25 mile (0.4 km) of any known denning sites during the lynx breeding season. Koehler (1990a) did not detect a detrimental influence of his presence at den sites on kitten survival. However, in more accessible areas, local predators may have learned to associate human scents with food. It is most important to be sensitive to this acclimation when prey is scarce. Therefore, the denning site disturbance buffer should also apply to passive human disturbance until lynx densities recover from threatened status.

- 5a. Potential den sites will be located as far from roads as practical (the goal is 0.25 mile or 0.4 km, Lloyd 1999), where DNR manages 20 percent or more of a LAU. Passive human disturbance to known or suspected den sites will be discouraged.**
- 5b. DNR will avoid harvesting non-designated Denning Habitat during the denning season (May 1 - July 31). Consultation with DNR biologists may also lead to application of seasonal timing restrictions if a sale area contains denning structure that is similar and contiguous to the best available in the section but lacks all structural components of the denning structure definition. For example, a sale in a LAU where DNR manages less than 20 percent of the LAU where only 5 acres of a 15-acre patch of denning structure is designated as a denning site.**